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TI Copper alloys for motor commutator materials
IN Mae, Yoshiharu; Yajima, Kenji; Ishida, Tokukazu
PA Mitsubishi Materials Corp, Japan
SO Jpn. Kokai Tokkyo Koho, 5 pp.
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| PI | JP 09041056 | A2 | 19970210 | JP 1995-214058 | 19950731 |
| AB | Title Cu alloys contg. 7.5-15% Ag, 1-50 ppm O2, and 0.05-1.2% Cr and/or 0.01-0.25% Zr have dispersed structure of 100-10,000/mm2 pptd. compds. with 0.2-5 .mu.m. The materials have good wearing resistance. | | | | |

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(54) 【発明の名称】 モーター整流子材

(57) 【要約】

【課題】 耐摩耗性およびアーク発生の少ないモーター整流子材を提供する。

【解決手段】 重量%で、Ag: 7.5~15%、酸素: 1~50ppmを含有し、さらに、Cr: 0.05~1.2%、Zr: 0.01~0.25%の内の1種または2種を含有し、残りがCuおよび不可避不純物からなる組成、並びに素地中に0.2~5 μ mの析出物が100~10000個/mm²分散した組織を有するCu合金からなるモーター整流子材。

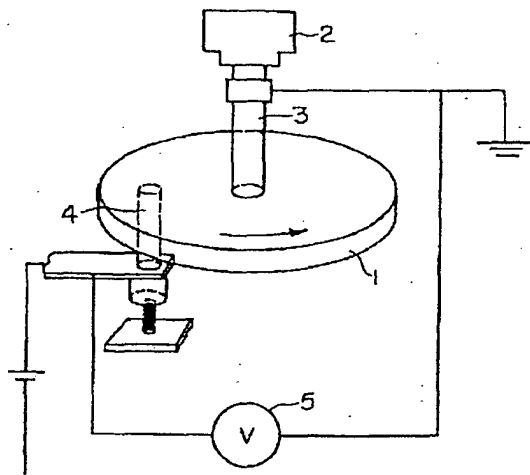
【図1】整流子材およびCu含浸カーボンブラシの摩耗量並びにアーク発生率を測定する方法を示す説明図である。

- 2 電動モーター
- 3 軸
- 4 Cu含浸カーボンブラシ
- 5 電圧計

【符号の説明】

1 整流子材

【図1】



PATENT ABSTRACTS OF JAPAN

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1)Application number : 07-214058

(71)Applicant : MITSUBISHI MATERIALS CORP

2)Date of filing : 31.07.1995

(72)Inventor : MAE YOSHIHARU

YAJIMA KENJI

ISHIDA TOKUKAZU

4) MOTOR COMMUTATOR MATERIAL

7)Abstract:

PROBLEM TO BE SOLVED: To produce a motor commutator material having wear resistance and small in generation of arcs.

SOLUTION: This motor commutator material consisting of a Cu alloy has a compsn. contg., by weight, 7.5 to 15% Ag and 1 to 50ppm oxygen, furthermore contg. one or two kinds of 0.05 to 1.2% Cr and 0.01 to 0.5% Zr, and the balance Cu with inevitable impurities and has a structure in which precipitates of 0.2 to 5 μ m are dispersed in the matrix by 100 to 10000 pieces/mm². The material is small in mating attackability.

LEGAL STATUS

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mode of final disposal of application other than the abandonment

examiner's decision of rejection or application

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number of appeal against examiner's decision of rejection]

date of requesting appeal against examiner's decision of rejection]

date of extinction of right]

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AIMS

[aim]

aim 1] A 0.2-5-micrometer sludge is 2 100-10000 pieces/mm in the composition which oxygen:1-50ppm are contained Ag:7.5-15% and Cr:0.05-1.2%, and the remainder becomes from Cu and an unescapable impurity by weight and a base. Motor commutator material characterized by consisting of a Cu alloy which has the decentralized organization.

aim 2] Motor commutator material characterized by consisting of a Cu alloy which has the composition which oxygen:1-50ppm are contained Ag:7.5-15% and Zr:0.01-0.25%, and the remainder becomes from Cu and an unescapable impurity by weight %, and the organization which 100-10000 0.2-5-micrometer sludges /distributed two es mm in the base.

aim 3] A 0.2-5-micrometer sludge is 2 100-10000 pieces/mm in the composition which oxygen:1-50ppm are contained Ag:7.5-15%, Cr:0.05-1.2%, and Zr:0.01-0.25%, and the remainder becomes from Cu and an unescapable impurity by weight %, and a base. Motor commutator material characterized by consisting of a Cu alloy which has the centralized organization.

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DETAILED DESCRIPTION

etailed description]

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the technical field to which invention belongs] This invention relates to the motor commutator material with few rates
 arcing with little [and] abrasion resistance and the partner aggression.

021

for art] Although it is known conventionally that Cu alloy with which % contains Ag:(which shows weight % eafter)10% by weight % as for motor commutator material, and the remainder consists of Cu and an unescapable purity will be used Recent years, Zr, Ag, Cr, Fe, Si, aluminum, B, calcium, Co, In, 0.05 - 7% is contained for one in Mg, Mn, nickel, P, Pb, Sb, Sn, Te, Ti, and Zn, or two sorts or more in the sum. The composition which the remainder becomes from Cu and an unescapable impurity, And the motor commutator material which was excellent in one layer abrasion resistance which has the precipitation organization which the precipitation grain not more than micelle-diameter:1000 Å distributed by grain-spacing:10-100 Å in the base is proposed (refer to publication-number 37 [three to] official report). These motors commutator material is included in the motor, where Cu impregnation on brush is contacted.

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ject of the Invention] As for various motors, it is asked for enhancement with the much more performance in recent years. for the reason While the rotational frequency of the commutator of a motor is raised, the forcing pressure of the commutator of a motor and Cu impregnation carbon brush is enlarged so that the contact resistance of the commutator of a motor and Cu impregnation carbon brush may become small. the forcing pressure of the commutator of the conventional motor, and Cu impregnation carbon brush -- 0.2-0.5kgf/cm² it was -- a thing -- present -- 0.7kgf/cm² It increases to the above and the service condition of the motor commutator material of a motor is still severer. as mentioned above, it is now although it is asked for the material of the motor commutator which wear of Cu impregnation carbon brush also increases and can bear such a severe condition while the rate of arcing will increase if the rotational frequency of a commutator is raised, and wear of the commutator [itself] of a motor will increase, if the forcing pressure of the commutator of a motor and Cu impregnation carbon brush is increased further -- it does not

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means for solving a technical problem] Then, the result which inquired that this invention persons should get the outstanding motor commutator material which can bear a severe condition rather than the former from such a point, The motor commutator material which consists of a Cu alloy which many Ag is contained rather than the mentioned conventional motor commutator material, and Cr and Zr were added [alloy] fewer and made 1-50 of oxygen contain further Abrasion resistance improved much more rather than the aforementioned conventional or commutator material, there were few rates of arcing and the knowledge of having the outstanding property was fired.

5] This invention is made based on such knowledge (1). It is weight %. Oxygen:1-50ppm are contained Ag:7.5-15% and Cr:0.05-1.2%. A 0.2-5-micrometer sludge is 2 100-10000 pieces/mm in the composition which the remainder becomes from Cu and an unescapable impurity, and a base. Motor commutator material which consists of a Cu alloy which has the decentralized organization (2), By weight % Oxygen:1-50ppm are contained Ag:7.5-15% and Zr:0.01-0.25%. A 0.2-5-micrometer sludge is 2 100-10000 pieces/mm in the composition which the remainder becomes from Cu and an unescapable impurity, and a base. Motor commutator material which consists of a Cu alloy which has the centralized organization. (3) A 0.2-5-micrometer sludge is 2 100-10000 pieces/mm in the composition which contains 1-50ppm are contained Ag:7.5-15%, Cr:0.05-1.2%, and Zr:0.01-0.25%, and the remainder becomes from Cu

d an unescapable impurity by weight %, and a base. It has the characteristic feature in the motor commutator material which consists of a Cu alloy which has the decentralized organization.

106] In the motor commutator material of this invention, since Cu impregnation carbon brush which is partner material is worn while a degree of hardness will be too high and workability will fall as motor commutator material if Ag is preferably contained on the other hand exceeding 15% since having carried out Ag content to 7.5 - 15% runs short of the intensity and hardness of motor commutator material if Ag becomes less than 7.5%, it is based on it not being desirable. The much more desirable composition domain of Ag content of the motor commutator material of this invention is 9.0 - 11.0%.

107] Moreover, since Cr content was carried out to 0.05 - 1.2% because abrasion resistance and thermal resistance could not be improved, if Cr becomes less than 0.05%, its arcing will increase on the other hand if Cr is contained exceeding 1.2%, and workability also becomes bad, it is based on it not being desirable. The much more desirable composition domain of Cr content of the motor commutator material of this invention is 0.2 - 0.6%.

108] Furthermore, since workability also becomes bad while arcing will increase if it contains on the other hand preferably exceeding 0.25% since thermal resistance runs short of this component at less than 0.01%, the ground which limited Zr contained in the motor commutator material of this invention to 0.01 - 0.25% is based on it not being desirable. The much more desirable composition domain of Zr contained in the motor commutator material of this invention is 0.05 - 0.15%.

109] Furthermore, since workability also becomes bad while arcing will increase if oxygen contains on the other hand preferably exceeding 50 ppm since the ground which limited the oxygen contained in the motor commutator material of this invention to 1-50 ppm requires a cost for setting oxygen to less than 1 ppm too much, it is based on it not being desirable. The much more desirable composition domain of the oxygen contained in the motor commutator material of this invention is 1-15 ppm.

110] [state of implementation of invention] While Cu alloy was melted by the usual RF smelter and deoxidation processing which stands was performed, the ingot which has the dimension (diameter:175mm and length:400mm) which has the component composition shown in Table 1 and 2 was produced by adjusting the amount of Ag, Cr, and Zr which are added in the molten metal which carried out the seal with solid-state carbon. After carrying out a cold-chamber manipulation after 720 degrees C and the hold during 60 minutes homogenize the obtained ingot until refined between heat and it carried out so that it might become a dimension (diameter:50mm and length:7600mm), then it subsequently carried out water cooling with the cooling rate of 50 degrees C/second or more and it was further refined to diameter:45mm, for 450 degrees C and 60 minutes, the hold carried out the aging treatment, the cold-drawing manipulation was carried out further, and the diameter:40mm round bar made from Cu alloy was produced.

11] The round bar made from these Cu alloy was cut to thickness:8mm, and the motor commutator material (conventionally henceforth commutator material) 1-4 was produced the disk-like this invention motor commutator material (henceforth this invention commutator material) 1-11, the comparison motor commutator material (henceforth comparison commutator material) 1-4, and conventionally. The cut surface of the obtained motor commutator material was ground, it observed with the metaloscope, the number of the 0.2-5-micrometer sludges currently distributed in the surface base of motor commutator material was measured, and the result was shown in Table 1 and 2. Cu impregnation carbon brush which has the dimension (diameter:5mm and length:10mm) which made porous material can impregnate Cu furthermore was prepared.

12] The these disks-like commutator material 1 is attached in the shaft 3 of an electrical motor 2 as shown in Figure 1. Cu impregnation carbon brush 4 is pushed against a 15mm place from the center of the disk-like commutator material 1, rotating the disk-like commutator material 1. making the graph which applied the constant voltage of 10V between the disk-like commutator material 1 and Cu impregnation carbon brush 4, measured the voltage which appears in a voltmeter 5, took the voltage along the axis of ordinate and took the resistance welding time along the quadrature axis draw The abrasion test was performed on condition that the following, the abrasion loss and rate of arcing of commutator material and Cu impregnation carbon brush were measured, and the result was shown in Table 1 and 2. In addition, since the voltage became less than [9V] when the arc occurred, the rate of the resistance welding time from which the voltage to all the resistance welding times became less than [9V] was made into the rate of arcing.

13] Abrasion test condition **** current:15A (76.43A/cm²), **** voltage:10V, forcing pressure:250gf (7kgf/cm²), turnover-time:24 hour, and rotational frequency:10000rpm.

14] [Example 1]

| 種 別 | 成 分 組 成 (重量%, 但しO ₂ (ppm)) | | | | | 析出物の個数 (個/mm ²) | 整流子の摩耗量 (mg) | Cu含浸カーボン ブラシの摩耗量 (mg) | アーク発生率 (%) | |
|---------------------------------|---------------------------------------|------|------|----------------------|----|--------------------------------|-----------------|-----------------------------|---------------|------|
| | Ag | Cr | Zr | O ₂ (ppm) | Cu | | | | | |
| 本 発 明 整 流 子 材 | 1 | 9.5 | 0.12 | — | 5 | 残 | 7500 | 430 | 9 | 10.2 |
| | 2 | 8.5 | 0.85 | — | 5 | 残 | 9200 | 550 | 8 | 14.3 |
| | 3 | 8.1 | — | 0.08 | 4 | 残 | 1500 | 520 | 7 | 8.4 |
| | 4 | 12.3 | — | 0.21 | 3 | 残 | 3200 | 400 | 12 | 9.3 |
| | 5 | 7.6 | 0.30 | 0.07 | 6 | 残 | 5300 | 410 | 10 | 12.3 |
| | 6 | 7.8 | 0.85 | 0.08 | 10 | 残 | 8500 | 580 | 11 | 13.2 |
| | 7 | 10.3 | 0.33 | 0.23 | 8 | 残 | 6200 | 470 | 11 | 12.5 |
| | 8 | 10.3 | 0.98 | 0.06 | 16 | 残 | 9400 | 620 | 12 | 14.0 |
| | 9 | 14.3 | 0.10 | 0.10 | 23 | 残 | 7900 | 440 | 10 | 11.4 |
| | 10 | 14.2 | 0.77 | 0.08 | 31 | 残 | 8800 | 570 | 11 | 10.7 |
| | 11 | 9.8 | 0.07 | 0.03 | 50 | 残 | 9500 | 640 | 13 | 17.2 |

15]
able 2]

| 種 別 | 成 分 組 成 (重量%, 但しO ₂ (ppm)) | | | | | 析出物の個数 (個/mm ²) | 整流子の摩耗量 (mg) | Cu含浸カーボン ブラシの摩耗量 (mg) | アーク発生率 (%) |
|-----|---------------------------------------|------|------|----------------------|----|--------------------------------|-----------------|-----------------------------|---------------|
| | Ag | Cr | Zr | O ₂ (ppm) | Cu | | | | |
| 1 | 5.4* | 0.27 | 0.12 | 120* | 残 | 22100 | 980 | 43 | 33.4 |
| 2 | 17* | 0.08 | 0.09 | 65* | 残 | 12500 | 1050 | 47 | 39.6 |
| 3 | 8.4 | 1.5* | 0.12 | 18 | 残 | 25300 | 1140 | 38 | 28.8 |
| 4 | 10.2 | 0.45 | 0.4* | 6 | 残 | 15600 | 920 | 48 | 29.3 |
| 1 | 11.3 | — | — | — | 残 | — | 925 | 8 | 9.4 |
| 2 | 4.0 | — | — | — | 残 | — | 850 | 11 | 10.2 |
| 3 | 0.03 | 0.02 | 0.03 | — | 残 | 5300 | 1020 | 13 | 12.3 |
| 4 | 2.1 | — | — | — | 残 | — | 980 | 14 | 11.8 |

(*印は、この発明の条件から外れた値を示す)

6]

ect of the invention] From the result shown in Table 1 and 2, this invention commutator material 1-11 Ag, Cr from ch it separated from the motor commutator material 1-4 and this invention conventionally, Compared with the parison motor commutator material 1-4 containing Zr and oxygen, there is little abrasion loss of the commutator rial [itself]. moreover, the rate of arcing is markedly alike, becomes large, and it turns out that the comparison

motor commutator material which there are few amounts which wear the carbon brush which is partner material, and
it has too many one sort or two sorts, and oxygen contents of Cr and the Zr is not desirable As mentioned above, the
motor commutator material of this invention can raise the luminous efficacy of a motor, and the effect excellent in
development of electric industry is brought.

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TECHNICAL FIELD

[The technical field to which invention belongs] This invention relates to the motor commutator material with few rates
of arcing with little [and] abrasion resistance and the partner aggression.

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JOR ART

rior art] Although it is known conventionally that Cu alloy with which % contains Ag:(which shows weight % reafter)10% by weight % as for motor commutator material, and the remainder consists of Cu and an unescapable purity will be used Recent years, Zr, Ag, Cr, Fe, Si, aluminum, B, calcium, Co, In, 0.05 - 7% is contained for one t in Mg, Mn, nickel, P, Pb, Sb, Sn, Te, Ti, and Zn, or two sorts or more in the sum. The composition which the nainder becomes from Cu and an unescapable impurity, And the motor commutator material which was excellent in : one layer abrasion resistance which has the precipitation organization which the precipitation grain not more than ticle-diameter:1000 A distributed by grain-spacing:10-100 A in the base is proposed (refer to publication-number 437 [three to] official report). These motors commutator material is included in the motor, where Cu impregnation bon brush is contacted.

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EFFECT OF THE INVENTION

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TECHNICAL PROBLEM

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05] This invention is made based on such knowledge (1). It is weight %. Oxygen:1-50ppm are contained Ag:7.5-% and Cr:0.05-1.2%. A 0.2-5-micrometer sludge is 2 100-10000 pieces/mm in the composition which the remainder comes from Cu and an unescapable impurity, and a base. Motor commutator material which consists of a Cu alloy which has the decentralized organization (2), By weight % Oxygen:1-50ppm are contained Ag:7.5-15% and Zr:0.01-5%. A 0.2-5-micrometer sludge is 2 100-10000 pieces/mm in the composition which the remainder becomes from and an unescapable impurity, and a base. Motor commutator material which consists of a Cu alloy which has the centralized organization. (3) A 0.2-5-micrometer sludge is 2 100-10000 pieces/mm in the composition which /gen:1-50ppm are contained Ag:7.5-15%, Cr:0.05-1.2%, and Zr:0.01-0.25%, and the remainder becomes from Cu l an unescapable impurity by weight %, and a base. It has the characteristic feature in the motor commutator material ich consists of a Cu alloy which has the decentralized organization.

06] In the motor commutator material of this invention, since Cu impregnation carbon brush which is partner terial is worn while a degree of hardness will be too high and workability will fall as motor commutator material if is preferably contained on the other hand exceeding 15% since having carried out Ag content to 7.5 - 15% runs rt of the intensity and hardness of motor commutator material if Ag becomes less than 7.5%, it is based on it not ng desirable. The much more desirable composition domain of Ag content of the motor commutator material of this ention is 9.0 - 11.0%.

07] Moreover, since Cr content was carried out to 0.05 - 1.2% because abrasion resistance and thermal resistance ld not be improved, if Cr becomes less than 0.05%, its arcing will increase on the other hand if Cr is contained eeding 1.2%, and workability also becomes bad, it is based on it not being desirable. The much more desirable iposition domain of Cr content of the motor commutator material of this invention is 0.2 - 0.6%.

08] Furthermore, since workability also becomes bad while arcing will increase if it contains on the other hand emably exceeding 0.25% since thermal resistance runs short of this component at less than 0.01%, the ground which ted Zr contained in the motor commutator material of this invention to 0.01 - 0.25% is based on it not being rable. The much more desirable composition domain of Zr contained in the motor commutator material of this ntion is 0.05 - 0.15%.

09] Furthermore, since workability also becomes bad while arcing will increase if oxygen contains on the other d preferably exceeding 50 ppm since the ground which limited the oxygen contained in the motor commutator aria. of this invention to 1-50 ppm requires a cost for setting oxygen to less than 1 ppm too much, it is based on it eing desirable. The much more desirable composition domain of the oxygen contained in the motor commutator erial of this invention is 1-15 ppm.

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[state of implementation of invention] While Cu alloy was melted by the usual RF smelter and deoxidation essing which stands was performed, the ingot which has the dimension (diameter:175mm and length:400mm) h has the component composition shown in Table 1 and 2 was produced by adjusting the amount of Ag, Cr, and Zr h and added in the molten metal which carried out the seal with solid-state carbon. After carrying out a cold-

rawing manipulation after 720 degrees C and the hold during 60 minutes homogenize the obtained ingot until struded between heat and it carried out so that it might become a dimension (diameter:50mm and length:7600mm), and it subsequently carried out water cooling with the cooling rate of 50 degrees C/second or more and it was further cut to diameter:45mm, for 450 degrees C and 60 minutes, the hold carried out the aging treatment, the cold-drawing manipulation was carried out further, and the diameter:40mm round bar made from Cu alloy was produced [011] The round bar made from these Cus alloy was cut to thickness:8mm, and the motor commutator material (conventionally henceforth commutator material) 1-4 was produced the disk-like this invention motor commutator material (henceforth this invention commutator material) 1-11, the comparison motor commutator material (henceforth comparison commutator material) 1-4, and conventionally. The cut surface of the obtained motor commutator material was ground, it observed with the metaloscope, the number of the 0.2-5-micrometer sludges currently distributed in the cut-surface base of motor commutator material was measured, and the result was shown in Table 1 and 2. Cu impregnation carbon brush which has the dimension (diameter:5mm and length:10mm) which made porous material carbon impregnate Cu furthermore was prepared.

[012] The these disks-like commutator material 1 is attached in the shaft 3 of an electrical motor 2 as shown in drawing 1. Cu impregnation carbon brush 4 is pushed against a 15mm place from the center of the disk-like commutator material 1, rotating the disk-like commutator material 1. making the graph which applied the constant voltage of 10V between the disk-like commutator material 1 and Cu impregnation carbon brush 4, measured the voltage which appears in a voltmeter 5, took the voltage along the axis of ordinate and took the resistance welding time along the quadrature axis draw The abrasion test was performed on condition that the following, the abrasion loss and the rate of arcing of commutator material and Cu impregnation carbon brush were measured, and the result was shown Table 1 and 2. In addition, since the voltage became less than [9V] when the arc occurred, the rate of the resistance welding time from which the voltage to all the resistance welding times became less than [9V] was made into the rate of arcing.

[013] The abrasion test condition **** current:15A (76.43A/cm²), **** voltage:10V, forcing pressure:250gf (27kg/cm²), turnover-time:24 hour, and rotational frequency:10000rpm.

[014]
Table 1

| 試料番号 | 成分組成 (重量%, 但しO ₂ (ppm)) | | | | | 析出物の組織 (個/mm ²) | 炭素子の摩耗量 (mg) | Cu含炭カーボン ブラシの摩耗量 (mg) | アーク発生率 (%) |
|------|------------------------------------|------|------|----------------------|----|--------------------------------|-----------------|-----------------------------|---------------|
| | Ag | Cr | Zr. | O ₂ (ppm) | Cu | | | | |
| 1 | 5 | 0.12 | — | 5 | 残 | 7500 | 430 | 9 | 10.2 |
| 2 | 8.5 | 0.85 | — | 5 | 残 | 9200 | 550 | 8 | 14.3 |
| 3 | 1 | — | 0.08 | 4 | 残 | 1500 | 520 | 7 | 8.4 |
| 4 | 1.3 | — | 0.21 | 3 | 残 | 3200 | 400 | 12 | 9.3 |
| 5 | 6 | 0.30 | 0.07 | 6 | 残 | 5300 | 410 | 10 | 12.3 |
| 6 | 8 | 0.85 | 0.08 | 10 | 残 | 8500 | 580 | 11 | 13.2 |
| 7 | 10.3 | 0.33 | 0.23 | 8 | 残 | 6200 | 470 | 11 | 12.5 |
| 8 | 13 | 0.98 | 0.06 | 16 | 残 | 9400 | 620 | 12 | 14.0 |
| 9 | 13 | 0.10 | 0.10 | 23 | 残 | 7900 | 440 | 10 | 11.4 |
| 10 | 14.2 | 0.77 | 0.08 | 31 | 残 | 8800 | 570 | 11 | 10.7 |
| 11 | 18.3 | 0.07 | 0.03 | 50 | 残 | 9500 | 640 | 13 | 17.2 |

| 題 列 | 成 分 組 成 (重量%, 但しO ₂ (ppm)) | | | | | 析出物の個数 (個/m ²) | 整流子の摩耗量 (mg) | Cu含浸カーボン ブラシの摩耗量 (mg) | アーク発生率 (%) |
|-----|---------------------------------------|------|------|----------------------|----|-------------------------------|-----------------|-----------------------------|---------------|
| | Ag | Cr | Zr | O ₂ (ppm) | Cu | | | | |
| 1 | 5.4* | 0.27 | 0.12 | 120* | 残 | 22100 | 980 | 43 | 33.4 |
| 2 | 3.7* | 0.08 | 0.09 | 65* | 残 | 12500 | 1050 | 47 | 39.6 |
| 3 | 2.4 | 1.5* | 0.12 | 18 | 残 | 25300 | 1140 | 38 | 28.8 |
| 4 | 12.2 | 0.45 | 0.4* | 6 | 残 | 15600 | 920 | 48 | 29.3 |
| 1 | 1.3 | - | - | - | 残 | - | 925 | 8 | 9.4 |
| 2 | 1.0 | - | - | - | 残 | - | 850 | 11 | 10.2 |
| 3 | 0.03 | 0.02 | 0.03 | - | 残 | 5300 | 1020 | 13 | 12.3 |
| 4 | 0.1 | - | - | - | 残 | - | 980 | 14 | 11.8 |

(*)は、この発明の条件から外れた値を示す)

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NOTICES *

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*** marks the word which can not be translated.

In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[explanation of a drawing]

[drawing] It is explanatory drawing showing how to measure the abrasion loss and the rate of arcing of commutator of Cu impregnation carbon brush.

[explanation of a sign]

Commutator Material

Identical Motor

shaft

Cu impregnation Carbon Brush

Commutator

and also done.]

W. 1948 *

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*** shows the word which can not be translated.

in drawings, any words are not translated.

FIG. 1

FIG. 1

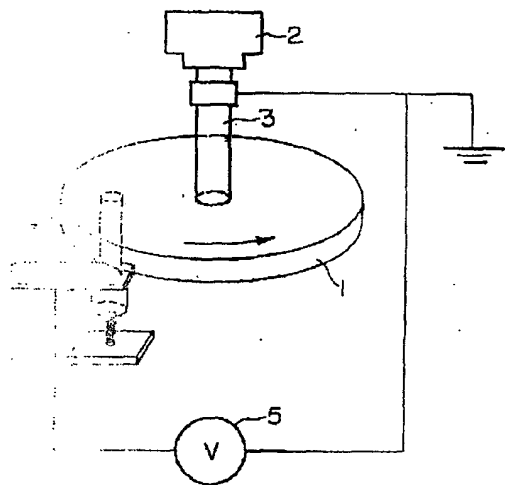


FIG. 1